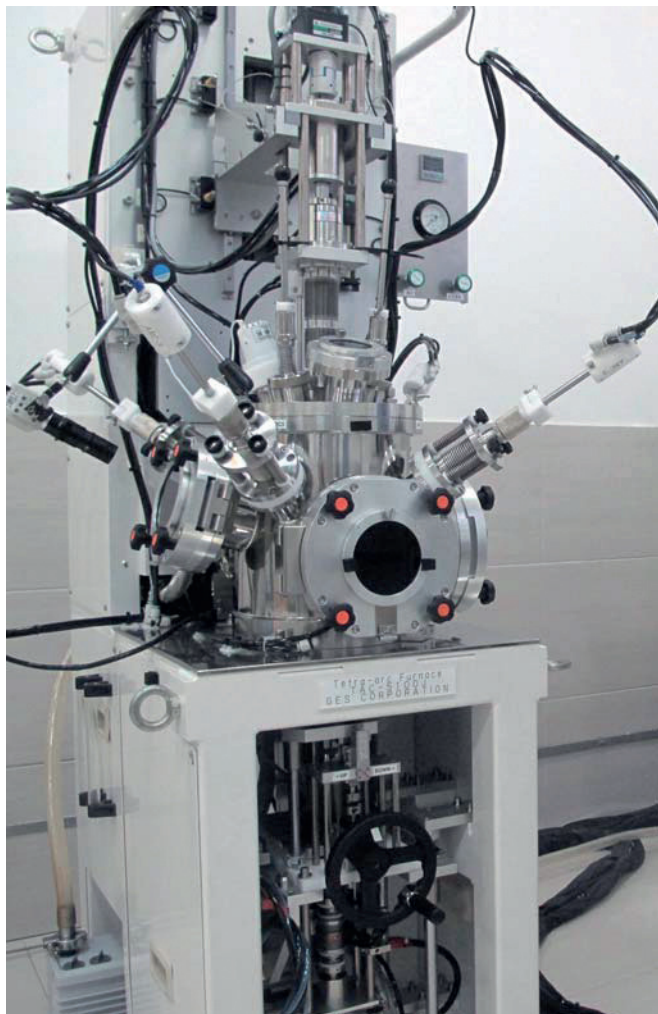


Tetra arc furnace for crystal growth



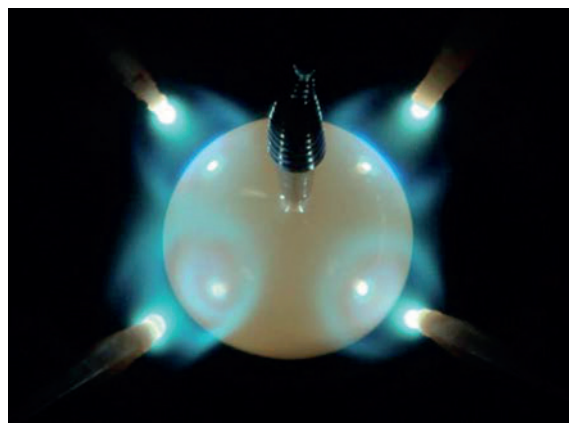
Features

- Single crystal growth by Czochralski pulling method
- Four electric arcs discharged in Ar gas to melt material up to 3000 °C
- 10^{-6} Torr vacuum within one hour to achieve high Ar gas purity
- Convenient handling of material and furnace
- Easy operation from control panel
- Real time monitoring of crystallization process

Capable of growing

- Metallic-conductive materials
- Metal compounds
- High temperature superconductors

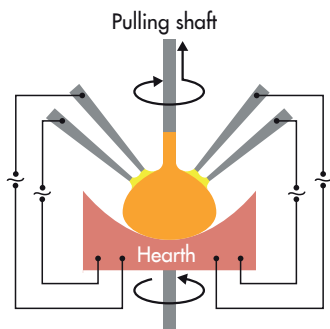
The tetra arc crystal furnace uses the Czochralski pulling method and four electric arcs to grow a wide range of metallic-conductive materials such as metallic compounds and high-temperature superconductors. It achieves a 10^{-6} Torr vacuum within an hour, and using four electric arcs to heat materials up to 3000 °C. This furnace provides easy operation and real time monitoring of the crystallization process via CCD camera and four monitoring windows.



Single crystal of CeRh_2Si_2 (cerium, rhodium, silicon), photo by GES

Tetra arc furnace for crystal growth

System principle for crystal growth



- Material, on rotated hearth, melted by 4 electric arcs discharged in Ar gas
- Material pulled for gradual cooling for single crystallization by pulling shaft (Czochralski pulling method)

4 (Tetra) arcs

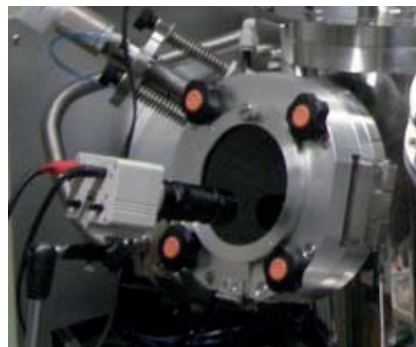
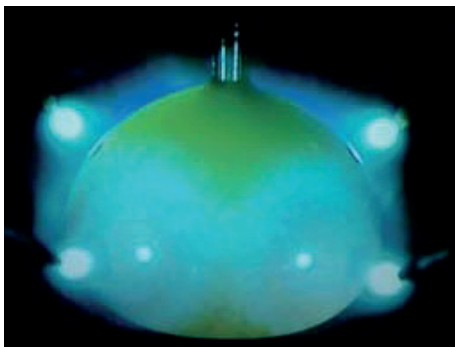


- 4x total arc power to melt material
- Uniform arc power by 4 arcs
- Easy control of arc power via control unit
- Direct manual control of arc position via arc electrode from outside of furnace

System composition	
Furnace unit	4 arc electrodes
	Pulling shaft
	Hearth
	Vacuum system
	Ti getter
Control unit	
Power supply unit	System control line
	Arc generators

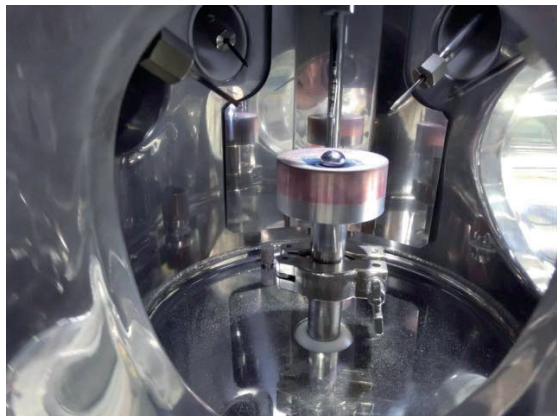
Real time monitoring

- Via CCD camera to check melting and pulling process to adjust arc power

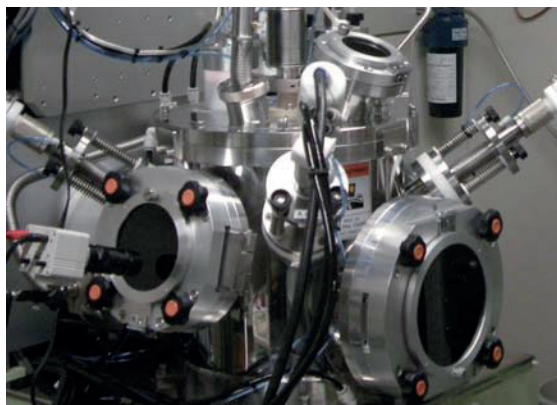


Tetra arc furnace for crystal growth

Convenient handling of furnace



- 4 monitoring windows (top/front/sides) of furnace
- Monitoring windows for sample placement and cleaning
- Top cover of furnace can be opened for easy maintenance and cleaning



Excellent vacuum system



- 10^{-6} Torr (within 1 hour)
- Turbo molecule pump (220 l/sec) directly connected to large 4" gate valve of furnace to maximize conductance
- $<1 \times 10^{-9}$ atm. cc/sec vacuum leak rate

Easy control via control unit



4 arc power volume

- Crystal growth parameters
 - Arc power control (each arc separately or all arcs at one time)
 - Hearth rotation
 - Pulling shaft rotation and pulling speed
- Vacuum pump control
- Malfunction alarm

Tetra arc furnace for crystal growth

Specification		
Furnace	Material and structure	Stainless steel (double walled + cooling water)
	Windows	Monitoring windows (top/front/side) open for sample placement and cleaning
	Working pressure range	5×10^{-6} Torr, ~ 1.1 Atm
	Vacuum discharge system	10^{-6} Torr (within 1 hour), turbo molecule pump : 220 l/sec + rotary pump : 100 l/min
	Vacuum gage measurement range	760 Torr $\sim 1 \times 10^{-9}$ Torr
	Main valve	4" gate valve (manual)
	Arc electrode/shaft	4 tungsten electrodes/stainless shafts (water cooling)
	Getter electrode/shaft	1 tungsten electrode/stainless shaft (water cooling)
Pulling shaft	Material and seal	Stainless/ferro-fluidic seal+bellows (water cooling)
	Pulling speed	0 – 39 mm/hr $\pm 1.0\%$ at full scale (servo-motor)
	Pulling stroke	150 mm
	Rapid travel speed	100 mm/min (fixed speed)
	Rotation speed	0 – 10 rpm
Hearth	Hearth material	Oxygen free copper (water cooling)
	Shaft material and seal	Stainless/ferro-fluidic seal+bellows (water cooling)
	Rotation speed	0 – 10 rpm
	Travel stroke	20 mm (manual)
Control unit	Crystal growth parameters (arc power, hearth rotation, shaft pulling and rotation), vacuum control, malfunction alarms	
Power supply unit	System control lines, four arc generators (for four arc electrodes), getter generator, transformer	
Monitor	Real time crystal growing monitor via CCD	
Size (W x D x H)	Furnace unit	1400 x 750 x 1200 (mm)
	Control unit:	600 x 550 x 1000 (mm)
	Power supply unit	1400 x 750 x 1200 (mm)
Weight	Furnace unit	380 kg
	Control unit	120 kg
	Power supply unit	600 kg
Power requirement	190 – 460 VAC, 50 – 60 Hz (20 KVA), 3-phase, 4 wires + ground	
Cooling water requirement	15 l/min, pressure 0.3~0.5 MPa, temperature <25 °C	

